

Express Mail No. EV241979260US

**PATENT APPLICATION OF**  
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**ENTITLED**  
**HEAD ACTUATOR ASSEMBLY INCLUDING A CIRCUIT**  
**BOARD OR CIRCUIT PORTION AND A DAMPING**  
**ASSEMBLY THEREFOR**

Docket No. S104.12-0063/STL 11496

## HEAD ACTUATOR ASSEMBLY INCLUDING A CIRCUIT BOARD OR CIRCUIT PORTION AND A DAMPING ASSEMBLY THEREFOR

### FIELD OF THE INVENTION

5       The present invention relates generally to a damping assembly for an actuator assembly, and more particularly but not by limitation to a damping assembly for an interface between a circuit board or circuit portion and head actuator assembly.

### BACKGROUND OF THE INVENTION

10       Data storage devices store digitally encoded information on discs. Heads read data from or encode or record information to discs or other data storage media. Heads are positioned relative to selected data tracks via operation of a head actuator assembly. The head actuator assembly typically includes an actuator block having a plurality of actuator arms extending therefrom having heads or head suspension assemblies coupled thereto. The heads are coupled to circuitry through an circuit  
15       board or circuit portion mounted or supported by the head actuator assembly. The actuator block is actuated or moved by a drive assembly or motor to position the actuator arms and heads relative to select data tracks on the disc surface to read or write information relative to the disc. Vibration of the actuator assembly can interfere with placement of the heads relative to the disc surface or in particular  
20       interfere with head positioning for recording servo information or patterns on a disc or discs. Embodiments of the present invention provide solutions to these and other problems and offer other advantages over the prior art.

### SUMMARY OF THE INVENTION

25       The present invention relates to an actuator assembly including a damping assembly between a circuit board or circuit portion and actuator block or body. The damping assembly is designed to control vibration modes of the actuator block excited via vibration of the circuit board or interface therefor. Other features and benefits that characterize embodiments of the present invention will be apparent

upon reading the following detailed description and review of the associated drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

5        FIG. 1 schematically illustrates an embodiment of an actuator assembly including an actuator block and circuit board or circuit portion and a damping assembly or interface therebetween.

      FIG. 2 schematically illustrates an embodiment of a servo track writing apparatus including an actuator assembly having an actuator block and circuit board  
10 or circuit portion and including a damping assembly therebetween.

      FIG. 3 is a schematic illustration of an embodiment of a servo track writing apparatus including an actuator block and circuit board or circuit portion and including a damping assembly therebetween.

      FIG. 4 is an exploded illustration of an embodiment of an actuator block and  
15 circuit board or circuit portion having a damping assembly interposed therebetween.

      FIG. 5 is an exploded view of an embodiment of a damping assembly interposed between a circuit board or circuit portion and an actuator block of a head actuator assembly.

      FIG. 6 is an exploded view of an embodiment of a damping assembly relative  
20 to a circuit interface portion of an actuator body or block.

      FIG. 7 is a top view illustrating the damping assembly between the actuator body and the circuit board or circuit portion.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

FIG. 1 schematically illustrates a head actuator assembly 100 which is movably supported via drive assembly 102 to position a head (or heads) 104 relative to a disc or data storage medium 106. In particular as shown, the head actuator assembly 100 includes an actuator block 108 having at least one actuator arm 110 extending therefrom. Head suspension assembly (or suspension assemblies) 114 are coupled to the actuator arm 110 to read or write (or encode) information relative to the data storage medium or disc 106. As shown, a circuit board or circuit portion (pre-amp card) 116 is secured relative to the actuator body 108 to provide an electrical interface between circuitry 118 and heads of the head suspension assemblies 114. The present invention relates to a damper assembly or damping interface 120 as illustrated schematically between the actuator block or body 108 and the circuit board or circuit portion 116 to limit or control excitation of vibration modes of the actuator assembly to reduce head placement errors.

As previously discussed, heads 104 are positioned relative to a disc or discs to read data from or write data (or encode servo information) to a disc or discs. Heads are positioned relative to data tracks on the disc or discs via a servo control system including servo information or patterns encoded on a disc or discs. For example, servo patterns or information can be encoded on a disc or discs between data sectors of each track of a disc "embedded servo information" or on a surface of a dedicated disc or "dedicated servo". Servo information or patterns are pre-recorded or written during manufacture of data storage devices for example, via a dedicated servo track writing apparatus 130 as illustrated in FIGS. 2-3. In the illustrated servo track writing apparatus 130, servo track information is recorded on a plurality of discs of a disc stack simultaneously to form a multiple disc servo track writing apparatus.

Embodiments of the damping assembly or damping interface have application for servo track writing apparatus and in particular for the multiple disc servo track writing apparatus 130 of FIG. 3. As shown the servo track writing apparatus 130 includes a head actuator assembly 100-1, which as shown in FIGS. 2-3, includes an actuator block 108-1. For encoding servo information or patterns a plurality of heads (or head suspension assemblies) are coupled to cantilevered actuator arms of the actuator block 108-1. The plurality of heads (or head suspension assemblies) are coupled to servo writing circuitry 132 to encode or record servo information through a circuit board or circuit portion 116-1 coupled to the actuator block as schematically illustrated in FIGS. 2-3.

Discs 106 (or disc stack - not shown in FIG. 3) are supported on a spindle hub 136 of a spindle block or assembly 138 for rotation by a spindle driver (not shown). The actuator block or assembly is coupled to a servo block 140 to position heads relative to a disc or discs supported on the spindle hub 136 to encode servo patterns or information on the discs or discs. For operation, discs are loaded onto the spindle hub 136 and are merged with the plurality of actuator arms or heads of the actuator assembly or block 108-1 to simultaneously recorded servo information to the plurality of discs 106 of the disc stack. In the illustrated embodiment, the spindle hub 136 has a generally horizontal position relative to a platform or base 144 (such as a granite platform or base) to vertically support discs (or a plurality of discs) for vertically orientated servo writing.

Discs are removably secured relative to the spindle hub 136 by a clamp. In the particular embodiment illustrated in FIG. 2, spindle hub 136 is stationary supported relative to the rigid platform or base 144 by spindle block 138 and the actuator block or assembly is movably supported relative to the base or platform 144

as illustrated by arrow 146 via servo block 140 to move or position the actuator block 108-1 and heads between a retracted position (shown in FIG. 2) and a merged position (not shown- FIG. 2) to record servo information to the discs.

In particular, the actuator assembly or actuator arms are retracted to load and  
5 unload discs on the spindle hub 136 and are merged to record servo information. As shown, the spindle assembly 138 includes an air dam 150 and stripper 152 which are movable between an opened position (shown in FIG. 2) to load and unload discs and a closed position to record servo information. Although in the illustrated embodiment, servo block 140 is movably supported relative to spindle block or  
10 assembly 138 to merge the heads suspension assemblies (heads) and discs, application is not so limited and the spindle block or assembly 138 or both the spindle block 138 and servo block 140 can be movable between a retracted position and a merged position to merge the heads and discs. Platform or base 144 is formed of a relatively impact or vibration resistant structure, such as a granite slab, to restrict  
15 movement of the apparatus or components during the servo writing process.

During operation vibration of the circuit board or circuit portion (pre-amp card) can excite vibration modes of the actuator block or assembly interfering with head placement. The present invention provides a damping assembly or interface 120-1 as schematically shown in FIGS. 2-3 between the circuit board or card 116-1 to  
20 limit or control excitation of vibration modes of the actuator block or body 108-2. In the embodiment illustrated in FIG. 4, the damping assembly 120-4 is coupled between a circuit interface portion 154 of the actuator body 108-4 and the circuit board 116-1. In the embodiment shown, the circuit interface portion 154 includes a window portion 156 to reduce inertia and mass of the actuator assembly. Damping  
25 assembly 120-4 is secured between the circuit interface portion 154 and the circuit

board 116-1 via fasteners 158 to provide mass and rigidity proximate to the circuit board 116-1 (and window portion 156) and to decouple the circuit board 116-1 from the actuator body 108-1 to limit excitation of vibration modes of the actuator block or body 108-1.

5        FIG. 5 is an exploded view of an embodiment of a damping assembly or interface 120-5 including a plurality of plates 180 secured relative to intermediate adhesive layers 182. In particular, in the embodiment shown the damping assembly or interface 120-5 includes a first damper plate 180-1, a second damper plate 180-2 and a third damper plate 180-3. Plates are formed of a relatively rigid material such  
10 as stainless steel. Damping plates 180-1, 180-2, 180-3 are secured via adhesive layers 182-1, 182-2 therebetween. In the embodiment described, adhesive layers are formed of a resilient or viscous material to provide a constraining layer between rigid plates. As shown, the damping assembly 120-5 includes damper pads 184-1, 184-2, 184-3, 184-4 adhesively secured relative to the rigid plates 180 via adhesive strips 186-1,  
15 186-2, 186-3, 186-4 to form a composite structure which interfaces relative to portion 154 of the actuator assembly.

      In particular in the embodiment of FIG. 6, damper pads 184-1, 184-2, 184-3, 184-4 are arranged to about window 156. The damper pads 184-1, 184-2, 184-3, 184-4 are adhesively secured to plate 180-1 to form the composite assembly which seats  
20 into a recess 190 formed by ribs 192 along recessed interface surface 194 as illustrated in FIGS. 6-7. As shown, pads 184 and adhesive strips 186 include cutouts 198 so that the pads and strips are contoured about fasteners 158. Similarly plates 180 and adhesive layers 182 have recessed corner portions 200 and cutouts 198 to contour plates 180 and adhesive layers 182 about ribs 192 and the fasteners 158. Pads 184  
25 abut the recessed interface surface 194. Thus as shown in FIG. 7, the damping

assembly is interposed between the circuit interface portion of the actuator body or assembly and the circuit board or portion 116-7 to control excitation of vibration modes of the actuator assembly, for example to control excitation of a body torsion mode of the actuator assembly.

5       The dimension or rigidity of the damper plates or assembly is designed to provide rigidity and mass proximate to the circuit board or portion to control excitation of vibration modes of the actuator body or block. In an illustrated embodiment, the damper plates have variable thickness dimension. In particular, the damper plate 180-1 proximate to the interface surface has a relatively thin thickness  
10   dimension and damper plates 180-2, 180-3 have a progressively larger thickness dimension in a direction away from the interface surface of the actuator assembly. In the illustrated embodiment, damper plate 180-1 has a thickness dimension of approximately 4 mils, damper plate 180-2 has a thickness dimension of approximately 6 mils and damper plate 180-3 has a thickness dimension of  
15   approximately 9 mils although application is not limited to any specific dimension or specific damper plates to decouple the actuator body from vibration modes of the circuit board or interface therefor.

It is to be understood that even though numerous characteristics and advantages of various embodiments of the invention have been set forth in the  
20   foregoing description, together with details of the structure and function of various embodiments of the invention, this disclosure is illustrative only, and changes may be made in detail, especially in matters of structure and arrangement of parts within the principles of the present invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed. For  
25   example, the particular elements may vary depending on the particular application



for the actuator block damper system while maintaining substantially the same functionality without departing from the scope and spirit of the present invention. In addition, although the preferred embodiment described herein is directed to an actuator block damper system for a servo writer, it will be appreciated by those  
5 skilled in the art that the teachings of the present invention can be applied to other storage devices such as disc drives, without departing from the scope and spirit of the present invention.